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ABSTRACT

This paper summarizes lessons learned from the creation and operation of a National Science Foundation-sponsored Engineering Education Coalition, the Southeastern University and College Coalition for Engineering Education (SUCCEED). Specific operational issues addressed include planning, organization, leadership, operations, support, participant involvement and evaluation. The development process effort takes patience and requires iteration. The lessons presented in this report should be of value to others who choose the path of a cooperative network to achieve educational research, development, and reform. (WRM)

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LESSONS LEARNED FROM OPERATING AN NSF EDUCATION COALITION

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Abstract

This paper summarizes the lessons learned from the creation and operation of an NSF Engineering Education Coalition. This will be of value to the design of other cooperative networks for engineering education development and reform. The specific coalition reported on is SUCCEED, the Southeastern University and College Coalition for Engineering Education. The cooperating consortium consists of eight Colleges of Engineering geographically located from Virginia to Florida. SUCCEED's mission was to create sustainable systemic engineering curriculum reform.

Cooperative networks for engineering education development and reform face initially two different problems. The first is to decide and agree on the purpose of creating the cooperating entity. The second question deals with how the coalition will function and operate.

This paper presents one set of answers to these questions in terms of the experiences and lessons learned from the conduct of SUCCEED over the past five years. The size and scope of this project are represented by the following statistics. NSF funding was $3 million per year for five years with a minimum match by the participating institutions and contributing industry. Over 80 educational innovation and process projects involving more than 220 faculty were supported. More than 3000 students were involved and impacted by project activities.

Specific operational issues addressed here are planning, organization, leadership, operations, support, participant involvement and evaluation. The development process effort takes patience and requires iteration. Mistakes were made, corrections were needed but success was achieved. The lessons learned by SUCCEED and presented here should be of value to others who choose the path of a cooperative network to achieve educational research, development and reform.

Introduction

SUCCEED, the Southeastern University and College Coalition for Engineering Education is one of eight consortia of engineering colleges supported under the National Science Foundation Engineering Education Coalitions (EEC) program. The purpose of this program is to create consortia of participants to share resources and results in addressing the problem of revising and reforming undergraduate engineering education in the United States for the twenty-first century. This permits groups of schools having expertise in different areas relating to engineering education to assist and learn from one another in dealing with problems that in many instances are common across their campuses. SUCCEED is composed of eight institutions located along the southeast coast of the United States from the states of Virginia to Florida. Participants include the engineering programs at Clemson University, Florida A&M University and Florida State University, Georgia Institute of Technology, North Carolina A&T State University, North Carolina State University, University of Florida, University of North Carolina at Charlotte and Virginia Polytechnic Institute and State University.

These eight schools submitted a joint proposal to the NSF EEC program that resulted in the Coalition being awarded five years of funding under a Cooperative Agreement with the National Science Foundation. The total award for five years was $15 million to be matched one for one by the participating institutions. North Carolina State University was designated the lead institution on the project. This required it to administer the project both programmatically and fiscally. Each of the eight coalitions supported by the NSF program selected a specific theme for its project activity. SUCCEED's theme was the creation and implementation of a new engineering education model.

The project was initiated in the spring of 1992 and the five-year period terminated in the summer of 1997. The coalition applied for a continuation of the project and was awarded funding under a second Cooperative Agreement with the National Science Foundation for an additional five years. Activity for year six of the project is now well underway.

Any cooperative network or consortium for engineering education development and reform faces two different but very important questions. The first is to decide and agree on the purpose for creating this cooperating entity. The second question has to do with how the consortium should be organized and operated. Organization and operations address many different issues but are related sufficiently to be grouped together.

Initial Planning

The question of why create a coalition is dealt with first

What purpose will it fill? What are its goals and objectives? Why use a coalition to achieve these desired goals? The factors influencing the answers to these questions are numerous and emerge from a variety of sources pursuing different agendas.

SUCCEED was born out of a desire to respond to and be part of creating solutions to problems recognized by the engineering education community and industry as to the proper preparation of engineering graduates to meet the technological needs of the country in the new millenium. The catalyst for SUCCEED was the opportunity for funding of a major attack on this problem from the newly announced NSF EEC program. A small group of interested faculty from several of the SUCCEED participating institutions began planning the potential creation of a consortium to respond to the EEC program request for proposals. The consortia envisioned by the National Science Foundation required groupings of institutions that met certain criteria in terms of women and minority enrollment as well as total enrollment. It was the desire of the NSF to have these consortia have a major impact on increasing both women and minority participation in the engineering profession.

With the large potential source for minority students in the southeast and a growing effort and commitment to address increased minority enrollment and graduation regionally it was natural to create a coalition of schools in this part of the country. This consortium would also possess some special and beneficial characteristics in addition to satisfying the enrollment criteria specified by the EEC program. This region contains a number of public supported institutions that produce proportionally a significant percentage of the nations total engineering graduates each year as well as large numbers of women and minority graduates. It also contains two of the nation's outstanding historic black engineering schools. There also existed a diversity of expertise and specialized campus interests among these schools that could bring special perspectives, resources and experience to all participants and the selected theme of the coalition.

This included, for example, a highly successful student preparation program for entering minority students at Georgia Tech. Virginia Tech had established a nationally recognized effort in multimedia and technology based program delivery. Strong internationally oriented industry involvement was underway at Clemson University. UNC Charlotte brought the perspective of an institution providing a highly urban oriented engineering program. North Carolina A&T State University, a strong historically black undergraduate engineering program, represented an institution striving to develop a recognized research and graduate program. As an upper division engineering school the University of Florida contributed the experience of dealing with large numbers of transfer students. FAMU-FSU represented the interests of a fast growing historically black engineering school emphasizing undergraduate education. North Carolina State University provided a long established effective design emphasis in engineering programs. It seemed only natural that with these special resources and interests the theme of creating a new engineering education model would be both a reasonable and desirable goal in addressing the problem of creating the engineering graduate for the twenty-first century.

Although not totally inclusive these were some of the more important factors that were influential in encouraging the initial planners to bring the current participating institutions together. Thus, the coalition was formed, consensus on its overarching goal of developing a new engineering curriculum model was achieved, special issues and agendas were addressed, the support of top administration was committed and a proposal was prepared and submitted to the NSF. Although this now can be stated as a simple list of completed tasks it took months of focused effort and many all day meetings to uncover special interests, deal with unique concerns and campus policies and negotiate resolutions acceptable to all parties involved.

The importance of this up-front effort in the initial planning phase for such a project can not be overemphasized. It is important to keep in mind that this was the bringing together of a group of parties who had long histories of being keen competitors for each others students, funding sources, industry support and faculty. The lesson here was to get those issues that might create future conflict or friction out on the table initially and deal with them. The hardest problem was uncovering and understanding what these special agendas were. It then became necessary to develop trust in each other to deal with them fairly. With an appreciation of the troubling issues and a basis of trust to work from, resolution can generally be achieved more easily than might first be anticipated. The time spent in this initial planning process is not only worth the effort but vital to future success of the coalition.

A Shared Vision

Agreement of the project participants to work together is of course necessary. However, without a shared vision that includes specific goals and objectives to be accomplished there is little value to be gained from a cooperative project effort. It is vital that the voice of all concerned parties be included and heard in the development of a truly shared vision. This again takes time and effort to assure that there is consistency on the part of all participants in their understanding of what the shared vision really means. This is particularly true where all interested parties may not be as involved in the creation of that vision as others. This important requirement caused some early misunderstandings between SUCCEED and the National Science Foundation. A brief review of this situation will help illustrate the point and further expand on the coalition theme.

SUCCEED's vision was to create sustainable engineering curriculum reform that would be ongoing even after the completion of the project. It proposed to accomplish this through the development and implementation of a new curriculum model among the participants of the Coalition and to disseminate this model and its components nationally. It defined its mission to be

the research, development, testing and evaluation, implementation and institutionalization of curriculum components and processes that would achieve the characteristics of this new curriculum model. These characteristics defined the nature of the educational experience to be delivered by the program and the attributes of the graduates it would produce.

> **Program Characteristics:** Subject content integration, early and multi-disciplinary design, explicit success skill development, exposure to professional practice, faculty development, technology based curriculum delivery, learning support systems and a continuous improvement culture.
>
> **Graduate Attributes:** Technical competence, critical and creative thinking, teaming, effective communication, global awareness, understanding of systems design and integration, pursuit of life long learning, display of high ethical standards, appreciation for the social context of engineering and an introduction to the business practices of industry.

The structure of the model was envisioned as being made up of three learning stages. Stage 1 prepared the student for learning the subject content of an engineering discipline. Stage 2 would provide the subject content of the discipline and the application of the relevant engineering sciences. Stage 3 would emphasize the development of student skills to synthesize the engineering knowledge in solving real problems involving consideration that go beyond the technical content. Connecting these three learning stages, which would in fact overlap, were three intermediate phases. A summer transitions program for new entering students preceding Stage 1. A community college interface program between Stage 1 and Stage 2. An industry oriented team internship experience program between Stage 2 and Stage 3. Each of the basic learning stage were further divided into subject content and experience areas that could over lap and integrate with one another. The model structure is illustrated below.

Summer Transition Programs

Stage 1 - Integrated Sciences, Mathematics, Humanities and Engineering
- *a. Integrated Mathematics, Science and Engineering*
- *b. Introductory Engineering and Design Experience*
- *c. Integrated Humanities, Technology, Social Sciences and Communications*

Community College Interface Programs

Stage 2 – Integrated Engineering Sciences, Process and Design
- *a. Engineering Process and Design*
- *b. Multidisciplinary Engineering Sciences and Practical Applications*

Industrial Oriented Team Experience

Stage 3 – Engineering Specialties & Integrated Engineering Practice
- *a. Engineering Practice Team Projects*
- *b. Engineering Functional Specialties*
- *c. Collateral Functional Specialties*

What the coalition leadership failed to do, as this model structure evolved and became the accepted internal basis for all the project activity that would take place, was to properly articulate how this would achieve the deliverables SUCCEED agreed to in accepting the Cooperative Agreement with the NSF. The interpretation by NSF of what SUCCEED planned to do as presented in its proposal was expressed explicitly in the Cooperative Agreement by the following four deliverables the coalition would produce.

1. Develop, implement and evaluate a new undergraduate engineering education curriculum model.
2. Implement Total Quality Management into the educational process and its management.
3. Increase significantly female and minority enrollment in engineering.
4. Promote engineering involvement and interaction with the K-14 educational system.

It soon became clear that the NSF had serious concerns about whether the coalition's plan would in fact achieve these deliverables. If not addressed and resolved this concern could have jeopardized the continuation of the entire project. Actually, the problem was not in what the coalition proposed to do since the plan included addressing these deliverables as part of the process of creating the model and its components. What SUCCEED had failed to do was properly articulate how its plan included specific activity to achieve these deliverables. The fact that the coalition did not make sure that the NSF understood how it was going to do this was the real problem. SUCCEED recognized the need to carefully describe, explain and "sell" its plan to faculty and top administration of the participating institutions as important customers who did not all participate in the creation of the plan. However, the Coalition did not include in this process, to the extent that it should have, the funding agency with which it had actually entered into a contractual agreement. Two important lessons emerge from this experience.

1. Make sure all important coalition customers and participants are identified.
2. Take the time and expend the necessary energy to insure that all these customers and participants

understand, accept and are supportive of what the coalition plans to undertake.

This is particularly true if all the parties have not been completely involved in the creation of the plan. It is also especially critical in those instances where the project's intent may be viewed as being directed toward making changes in well-established institutions and processes.

Organization

The second major question to be faced in forming a coalition or consortium is how should it be organized and operated. These involve a number of separate issues, which are closely related. Organization will be addressed first in terms of SUCCEED's experiences. In some instances this will overlap operations.

The EEC program specified that one institution should serve as the lead member of the coalition to provide both programmatic and fiscal administration for the entire project. The project director at the lead institution would be designated as the Principal Investigator and there would be a Co-Principal Investigator identified for each of the participating institutions. This carried with it the implication of responsibility and accountability for compliance with the terms of the Cooperative Agreement. The specific individuals making up this group was derived from the initial planning and proposal preparation participants. In some instances they were not necessarily the individuals that would direct the project activity on that campus.

The project proposal outlined an operational organization that consisted of a Coalition Director and staff at the lead institution supported by four Center Directors selected from across the coalition. These centers would be responsible for programmatic activity in the areas of (1) Curriculum Content and Integration, (2) Engineering Practice, (3) Professional Success and (4) Technology & Communication. The Deans of the participating institutions formed a Deans Council that functioned like a Board of Directors to which the Coalition Director reported periodically, one or twice yearly. The NSF also required the creation of an External Advisory Board that the coalition leadership met with annually to report on progress, review upcoming plans and obtain feedback and advice.

The project's administrative office at North Carolina State University began with the Coalition Director, an Assistant to the Director and a Coalition Secretary. This was soon expanded to add a Fiscal Manager to deal with the level of fiscal administration required. The Director and his staff devoted full time to the management and administration of the project. As principal investigator on the project the Director was also the Coalition's official contact with the Project Monitor at NSF.

An Associate Director was appointed from one of the smaller institutions to represent their interests since the four Center Directors came from the campuses of the largest institutions. A coalition Guidance Team to provide programmatic leadership was formed consisting of the Director, his Assistant, the Associate Director and the four Center Directors. As a regional coalition the Guidance Team could conveniently meet monthly on one of the eight campuses. This face to face interaction was critical in providing effective communication, insuring a continuing focus on current activity and the time and opportunity to build consensus for meeting upcoming needs and coalition wide events. It must be remembered that with the exception of the Director and his staff the remaining members of the coalition leadership team all had permanent faculty or administrative positions that required priority attention on their own campuses. Thus day and a half meetings away from personal offices permitted and insured total attention to the programmatic direction of the coalition.

An early need recognized by the Guidance Team was that to work effectively as a team it was necessary that its members quickly get to know each other strengths, weaknesses and personalities. To address this need the team underwent team training lead by a knowledgeable facilitator. This included Myers Briggs testing and evaluation, determining financial preferences and personalities, receiving formal training in effective team operations and spending a day at the Center for Creative Leadership in Greensboro, NC. Team meetings were also scheduled to provide for social interactions such as team dinners and invitations for the group to visit each other's homes.

It was soon recognized that representation from each participating institution was necessary on the Guidance Team to insure continuing contact with and involvement of all campuses. Diversity in terms of both gender and ethnicity was also addressed. Meeting all these needs brought the membership of the Guidance Team to eleven. This approached a level of participation, which would have made it difficult for the team to work effectively if it had not undergone the earlier described training. A specific coalition responsibility was assigned to each team member. This insured their active involvement with the team. The Co-Principal investigators named in the project award were designated Campus Representatives. In general they were not members of the Guidance Team. Their primary responsibility was to provide local administrative support for faculty receiving coalition funding to carry out specific project activity. As the designated representatives from their respective campuses they met annually with the Guidance team to plan and approve budgets for the following year's activity. This allowed them to participate in the budgeting process and thus discharge their responsibility as Co-Principal investigators on the award.

The initial membership of the External Advisory Board consisted of experts from academia, industry and the public sector with backgrounds, interest or involvement with engineering education. This did not result in an effective continuing involvement. A reconstitution of the EAB with membership drawn from the participant school Advisory Boards proved to be more effective. Their commitment to the institution on whose Advisory Board they served

resulted in greater interest in the activities of the Coalition.

Some of the more important lessons learned derived from SUCCEED's experience with what resulted in a successful and effective organizational structure were the following.

1. Operational and fiscal management of a large multi-institutional project like SUCCEED requires a full time director with appropriate staff support.
2. The director should share programmatic leadership of such a project with a team of committed and involved representatives from each participating institution.
3. To function effectively as a leadership team its members should receive appropriate and relevant team training.
4. The leadership team should meet regularly in some fashion that permits face to face interaction.
5. Scheduled meetings of the leadership team should be of sufficient frequency to maintain focus and momentum of the project's program of activity.
6. Each participating institution needs an identified individual to provide administrative support for individual project participation on that campus.
7. Each participating institution should play a meaningful role in the budget planning and approval process.
8. The top engineering administrators at the participant institutions should be organized to interact like a board of Directors with the Coalition Director and selected members of his team.
9. Members of advisory boards should be carefully chosen to insure their continuing commitment and involvement to the project.

Operations

Some of the more important issues concerning operations of a large multi-institutional project are now addressed in terms of the experiences encountered by SUCCEED. An important aspect of the Coalition not yet covered was by whom and how was project activity actually carried out. An early decision by the Guidance Team was that it would be necessary to identify that group of faculty on each campus that wanted to participate in the creation of the proposed curriculum model and who had something of importance and relevance to bring to the overall effort.

To identify this cadre each Center Director prepared a request for proposed faculty projects that would directly address that Center's responsibility of achieving the program characteristics, student attributes and structure of the curriculum model. These project needs from each Center were combined into a general solicitation for proposals that went out to all engineering and engineering support faculty on each participating campus. This solicitation resulted in more projects and funding requests then the Coalition could meet with its resources.

The submitted proposals were first separated into groups having relevance to the four Centers. Review teams, lead by a Center Director, prepared recommendations of projects to be funded. The four teams were composed of the remaining members of the Guidance Team and the Campus Representatives. Each of these participants served on two teams. A standard evaluation form was created and each team member reviewed and completed an evaluation form for each project before meeting as a team. In a two-day retreat these teams met and discussed relative strengths, weaknesses and potential contribution to the coalition's goals of each proposal. The Center Directors reported their team's recommendations for project funding to the combined Guidance Team and Campus Representatives. A final budget distribution was negotiated and approved under the Director's leadership.

This process identified a large cadre of faculty whose interests and potential contributions were consistent with the goals of the coalition. This also resulted, as anticipated, in many novel and original ideas for educational research and development. The first year awards supported some 150 faculty on over 40 projects. It is important to point out that project-funding awards were for one year only even though most of the proposals included multi-year funding budget requests. Funding commitments beyond a year were not possible since the NSF provided the resources on an annual basis.

This process, which the Coalition felt was successful in achieving the objective set for it, raised some concern with the NSF. They felt that the coalition was acting like a "mini" NSF in awarding these grants. To some extent this was a valid criticism. However, the Coalition quickly identified committed cadre of faculty. Both the extent and complexity of the needs of the curriculum model to be created were well addressed.

Having established an initial research program the next task was to get the funds to the faculty who would carry out the projects. This process was left to the discretion of the Coalition. The NSF simply made the total monetary award to the lead institution. This created the first of several fiscal management problems. To begin with every institution had its own system of processing research grants from an outside agency. This was how they each viewed SUCCEED and how they wanted to continue dealing with an outside funding agency. This was not acceptable to the SUCCEED administrative office since it needed a consistent singular process for fiscal interaction with each institution to account for the total award in a tractable manner. A workable system was developed that made use of open-ended subcontracts with each participating institution. This arrangement allowed for individually funded tasks to be added or deleted from the subcontract through a simple amendment process.

When faculty members were awarded funds for a project they would submit through their institution's research office a formal project proposal to the Coalition. This proposal met all the requirements of their institution's submission process and included a standard NSF budget sheet plus several other documentation requirements of the Grants and

Contracts office at North Carolina State University. Upon approval of the Coalition Director an amendment to the subcontract with the faculty member's institution was prepared and processed. Invoices against this task amendment to the subcontract where then honored and reimbursed by North Carolina State University. To insure that the appropriate matching funds were provided to the faculty member these had to appear on the standard NSF budget form and required signature approval by the appropriate individual on the faculty member's campus. In this way matching funds were guaranteed by the participating institution. This removed from the Coalition administrative office the task of verifying that the required matching monies were being provided since they were committed by the participating institution as part of the formal budget approval process.

This system also provided an easy mechanism for funding several faculty from different institutions working on the same approved project. The faculty members decided among themselves how they would distribute the total budget awarded to the project. Then each faculty member would submit his budget request through his own institution. The Campus Representative on the faculty member's campus provided assistance and support for local processing. All budgets would be approved as tasks under their individual institution's subcontract not to exceed the total sum awarded to the project. This eliminated the need for subcontracts between participating institutions and the transfer of funds from one campus to another. This made bookkeeping easier for each institution. The lead campus was the only one approving budgets and reimbursing invoices. The system worked very well but did require a full time fiscal manager in the Coalition administrative office.

A small but sometimes annoying problem was created for the Coalition by the manner in which the award was made. Recall that the PI was on the lead campus and that there was a designated co-PI on all other campuses. Without a co-PI on the lead campus questions and actions relating to faculty project funding on the lead campus were directed to the Coalition administrative office. This was remedied by appointing a Campus Representative for the lead campus to assist the local faculty with their campus administrative needs. Unfortunately, this did not totally eliminate the direction of inquiries that were not the province of the Coalition administrative office.

Another fiscal issue that all campuses and the Coalition had to cope with was a consequence of delayed receipt of annual funding notification from the NSF. The normal process of federally funded programs many times resulted in funds not being available for a new project year at the termination of the previous project year. Without this confirmation of continued funding the lead institution's research office would not approve new subcontract amendments. This meant that a campus had to carry the participating faculty for the interim period anticipating that the funding would eventually become available. If a campus was not willing to do this faculty had to stop project activity until funding became available. This was both aggravating and disruptive.

During the second year of operation the project approval process was conducted essentially as in the first year with one important difference. At about six months into the first faculty project activity the Guidance Team revisited what parts of the curriculum model were being addressed and where there were research gaps in the program effort. Based on this evaluation a second general solicitation was announced to fill the research gaps. This solicitation also included a request for continuation proposals for the projects awarded in the previous year. Again more proposals were received than could be funded and the review and budget approval process previously described was employed. One difference was that now both continuing and new proposals were reviewed together. The result was that there were some continuation proposals whose progress or relevance dictated that they be terminated, there were continuing proposals that were refunded and there were new proposals that were funded for the first time. The number of funded projects now approached seventy involving some 220 faculty.

In the third and subsequent years there were very few new projects funded. Emphasis was placed on integrating related ongoing project activity on different campuses into "mega-projects" and "deliverable teams". This was done to consolidate and focus individual project efforts towards the deliverables promised and to disseminate and transfer results of project effort to other campuses. Unfortunately, this made it difficult for new faculty to become involved and obtain funding for their potentially innovative ideas. This resulted in charges that the Coalition had become a closed "club" that excluded any new members. However, additional faculty were not restricted from becoming involved in ongoing projects. Also the transfer of project results from one campus to another was encouraged and could include faculty not previously involved. The coalition had to keep in mind that it was responsible for producing specific deliverables and simply could not afford to function as a benevolent funding agency.

Each year continuation proposals were requested, submitted and reviewed before the coalition budget was established and approved by the Guidance Team and the Campus Representatives. One of the most difficult problems faced in these subsequent years was to discontinue funding of projects that had obviously completed what they proposed to do without losing the support of that faculty member to the Coalition project as a whole. This often required terminating funding to faculty associates that one had established a close relationship with over the past several years. These were hard decisions that some found difficult to confront. It resulted in some stressful meetings for the Guidance Team and hard feelings among some of its members.

Scheduled reports, reviews and site visits required significant time and energy. On the other hand, they provided the means by which the project could continuously evaluate its own progress and take stock of where it was and

what it might need to change. A great deal of the feedback from review teams was very insightful and useful but there was also that which appeared to be the consequence of personal agendas. It was all part of what the coalition learned to deal with and helped us become stronger as a team with a common goal.

Some of the more important lessons to be carried away from these operational experiences can be summarized as follows.

1. It is essential to identify quickly those participants who are committed and have the desire to support and contribute through individual active project activity to any large educational research and development project.
2. The larger the group of involved faculty the more successful will be the impact of the development effort.
3. The process of soliciting project proposals and recommending awards as well as the planning and approving individual project and overall coalition budgets should provide involvement opportunity for all participating institutions and be viewed as fair and equitable.
4. The distribution system for resources works best if it is simple to implement and use, easy to understand, centralized, common but flexible and assign accountability where it should reside.
5. Keep in mind that coalitions are formed to provide the means for sharing expertise and resources among campuses and that this only occurs when faculty from different institutions combine their efforts into integrated projects directed toward established coalition goals and objectives.
6. Each campus needs to identify an individual who can coordinate and provide administrative assistance for participating faculty and who will represent that institution in coalition wide decision activity.
7. Learn to cope with the scheduled reviews and reports required of any large cooperative project and use them to advantage in self-assessment of the coalition's progress and needs.

Communications

This presentation of SUCCEED experience and lessons learned would not be complete without mention of the role and importance of communication in the operation of a multi-institutional educational development project. The meeting mechanisms employed to provide interaction and communicate information to the Guidance Team, The Campus Representatives, Deans Council and External Advisory Board have already been discussed. Other mechanisms were initiated to keep the faculty project participants informed of the progress and activity across the coalition.

One was the publication of a sixteen-page newsletter issued every quarter. The newsletter contained information on coalition plans and procedures of interest to project PIs as well as articles describing individual project progress and results prepared by project PIs. It also contained a calendar of relevant upcoming events in SUCCEED and the national academic community, reports of awards and recognition received by SUCCEED participants and announcements of upcoming conference requests for paper submission and participation. The newsletter was distributed widely to all faculty of the participating institutions, the national engineering academic community and industry to inform them of the progress and activity of the Coalition.

A second formal mechanism was the establishment of a two day SUCCEED Annual Conference held on the campus of one of the participating institutions. All faculty and participants were invited to attend. This annual event provided a conference environment in which project PIs could present their results in formal scheduled sessions, learn of other project activity and interact with colleagues of like interest from other institutions. Opportunities were available for social interaction and a favorite feature was a poster and demonstration session for all participants.

Center directors also took advantage of their visits to the different campuses for Guidance Team meetings to meet and talk with the faculty whose projects were being supported out of their Centers. The Coalition Director and his assistant made annual visits to each campus to report on the status of the project and update faculty on planned activity for the upcoming year.

Effective communication is critical to the success of projects like SUCCEED. Not only to keep participants informed about what is going on but to let them know of the interest and pride that the leadership has in what they are accomplishing and how it all fits into the grand plan. Providing up to date, relevant and informative information to coalition participants cannot be over emphasized.

Conclusions

The operation of a cooperative multi-institutional project for educational research and development like SUCCEED is both difficult and complex. However, it can be done successfully and its accomplishments will exhibit the influence and enhancement derived from collaborative interaction and sharing of expertise among participants of different institutions. Some of the most important guidelines to achieve this success are:

1. Decide whether the goals and objectives of the project will in fact benefit from a collaborative partnership and determine who the members should be to contribute to the total effort.
2. Conduct extensive initial planning that addresses individual participant member issues associated with the collaborative effort.
3. Establish a shared vision for which there is consensus agreement and commitment among the

major participants

4. Effectively communicate the vision and implementation plan to all major customers and other important players and resolve any misunderstandings early in the project.
5. Establish an appropriately supported centralized administrative office to provide programmatic and fiscal operational management.
6. Create a lean organizational structure that provides for involvement of all institutions in the overall operational planning and budget decision process at the highest level
7. Provide necessary training to members of the organizational structure to insure their team functionality
8. Develop mechanisms for periodic active interaction between members of the leadership group.
9. Identify quickly and provide for early participation those faculty who will conduct the research and development activities of the coalition.
10. Involve as many project faculty as is feasible and realistic to contribute to the achievement of the project objectives
11. Promote an appreciation among participants that deliverables must be produced, which may limit or require termination of some highly innovative but non-relevant projects.
12. Develop a system for resource distribution that can accommodate the differences in fiscal operations among participant institutions that at the same time possesses a consistency and flexibility necessary for centralized accounting procedures.
13. Establish appropriate means and mechanisms to insure effective communication and information dissemination among directly involved participants and across the coalition and beyond on the status of coalition plans, activity and progress.
14. Create advisory and oversight boards that are relevant and committed to the goals of the project and provide them with charges that insure their meaningful involvement.
15. Treat reviews, reports and site visits as opportunities to obtain feedback that can be used for continuous internal improvement of the total project.

These suggestions certainly don't cover all the guidelines that might be required in creating and operating a cooperative educational research and development project. No two such projects will ever be the same nor will their operational needs and constraints be similar. However, it is hoped that the experiences of SUCCEED and the suggestions offered may be of value in at least providing a general direction to pursue.

Last but not least, maintain an easily accessed sense of humor and don't take the issues and problems that continue to arise either personally or too seriously. People who have a commitment and dedication to a worthwhile cause can find ways to overcome the obstacles in their path particularly if they work together.